

CHAPTER 1

INTRODUCTION AND BACKGROUND

1-1. Purpose

The purpose of this manual is to explain the process of how the reliability data in appendix B of this manual regarding power generation, power distribution and Heating Ventilation and Air Conditioning (HVAC) components was developed. This manual is intended to summarize the entire process of obtaining the reliability metrics of the pre-described components and what types of facilities provided the data so that the facility engineer can understand the foundation behind the reliability metrics. Upon reading this document the facility engineer should be able to make a more knowledgeable assessment for applications of the data to support government, commercial, industrial and utility installations.

1-2. Scope

The information in this manual reflects the efforts of extensive hours of research and analysis, along with the cooperation and time of numerous facilities, in order to ascertain reliability characteristics of power generation, power distribution and HVAC components. This effort was sponsored by the U.S. Army Corps of Engineers, Power Reliability Enhancement Program (PREP) in order to establish reliability, availability, and maintainability characteristics of over 200 components related to command, control, communication, computers, intelligence, surveillance and reconnaissance (C4ISR) facilities. This manual describes the data collection and summarization of all of over 200 components. Collection of the data began in October 1991 and the final report was delivered in early 1994.

1-3. References

Appendix A contains a complete list of references used in this manual.

1-4. Background

The Power Reliability Enhancement Program established the data collection effort to determine the effects that “new technology” had on equipment, i.e., equipment installed after 1971, in regards to reliability and availability. Previous data collection efforts were completed in the early 1970’s by the Institute of Electronics and Electric Engineers (IEEE) Gold Book using data compiled in the 1950’s and 1960’s. However, PREP understood that this data was not only outdated, but also it did not fully address maintenance which plays a major role on availability. Therefore, the PREP office decided a new data collection effort must be undertaken in order to accurately assess their C4ISR facilities.

a. The results in this manual represent the culmination of a 24,000 man-hour effort to collect operational and maintenance data on over 200 power generation components, power distribution components and HVAC components. Some of the major components of focus of the data collection effort were gas turbine generators, diesel engine generators, electrical switchgear, cables, circuit breakers, boilers, piping, valves, pumps, motors and chillers. The information was obtained on a variety of commercial and industrial facility types. The primary focus of facility types were office buildings, hospitals, water treatment facilities, power generation plants, utilities, manufacturing facilities, school universities and bank computer centers. These facilities were chosen because they have similar types of components and applications with varying degrees of maintenance quality and operational characteristics.

b. In order to provide an accurate overall reliability analysis of the equipment, data collection guidelines and goals were established to ensure that sufficient operational and maintenance data were collected from the various facilities. If the database was to be representative of the average use of equipment then it was necessary to collect data from facilities with varying degrees of maintenance policies. Otherwise if the data represented only facilities with new equipment with an operational time of eight hours a day and a high degree of maintenance policies, then the data would only be applicable or accurate for those types of facilities.

c. Other minimum requirements were established to develop a comprehensive database that did not skew data in any one direction. Statistically, the more data collected, the more representative the data will be overall. Therefore, the final database had the following minimum requirements on each component:

(1) A minimum sample size of 40 like components from various sites would be sampled. Of the 40 components, data on no more than 10 like components from a single site could be used in the database.

(2) A minimum of five years of operational data would be collected for each component per site.

(3) A minimum of 3.5 million calendar hours collected for each component. This requirement can be met by either five years of data and a minimum sample size of 80 components using data on no more than 10 like components from a single site or 10 years of data and a minimum sample size of 40 components using data on no more than 10 like components from a single site.

d. In order to track both the component information (containing over 6,000 records of operational and maintenance data) and the contact information (containing over 4,000 records identifying information sources) a database system with flexible output capabilities was developed. The flexibility of the database's output capabilities aided in assessing the varying levels of data quality and maintenance quality during the analysis phase of the project. The final version of the database was loaded into Microsoft Access for universal portability.

e. The results of the data summarization indicated that the maintenance quality level was a major predictor of equipment availability. Therefore, the availability values presented represent an average level of maintenance across all of the data sources.

f. In addition, the data and the information obtained and presented in this technical manual can aid facility designers and engineers in evaluating different designs to minimize production/mission failure and to estimate the down times associated with various systems or sub-systems. The application theory to apply this data to your facility can be found in TM 5-698-3, *Reliability Primer for C4ISR Facilities*, and TM 5-698-1, *Reliability/Availability for Electrical and Mechanical Systems for C4ISR Facilities*. Facility types that require more maintenance time and systems that may benefit from redundancy or replacement can also be identified.